PPE for Fall Protection

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Outline

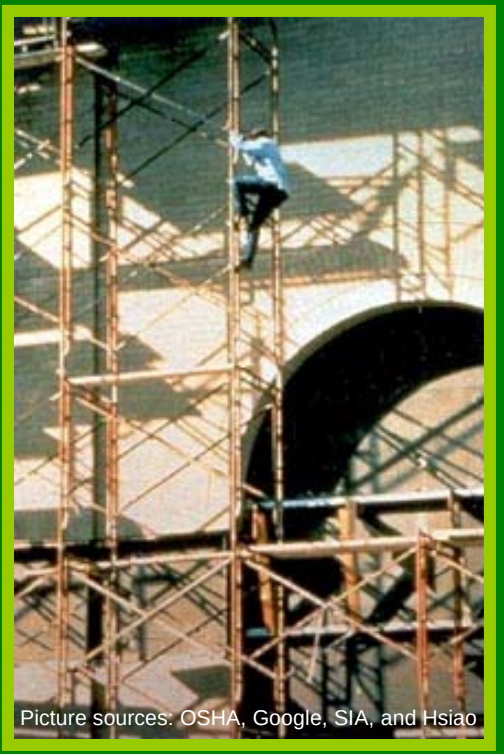
- Importance of the research problem
- NIOSH research and practice
  - Improving harness sizing system
  - Controlling suspension trauma
  - Controlling impact energy
- Strategic goals on PPE for falls

Importance of the problem (1/3)

651 fall fatalities and 86,900 injuries each year

Roof

Ladder



Scaffold

Importance of the problem (2/3)

OSHA Regulations (Standards - 29 CFR) 1926.502
Fall protection systems criteria and practices

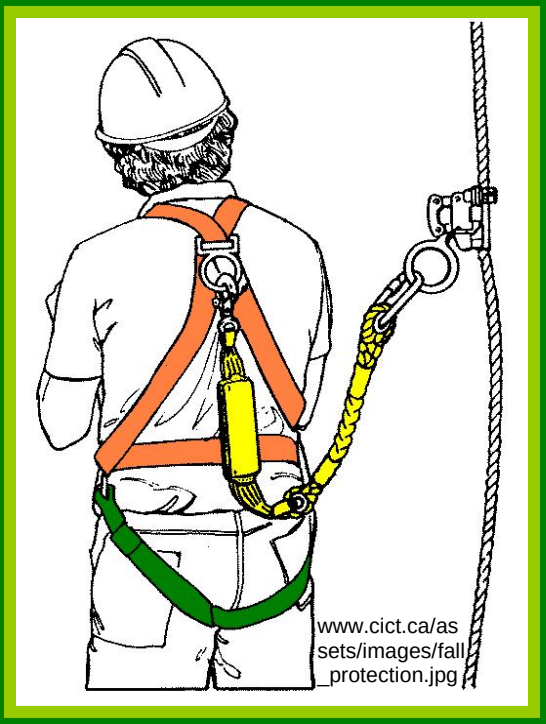
Safety net

Guard rail

PFAS

Importance of the problem (3/3)

The last line of defense for various tasks: Harness fit, suspension trauma relief, and impact energy absorber

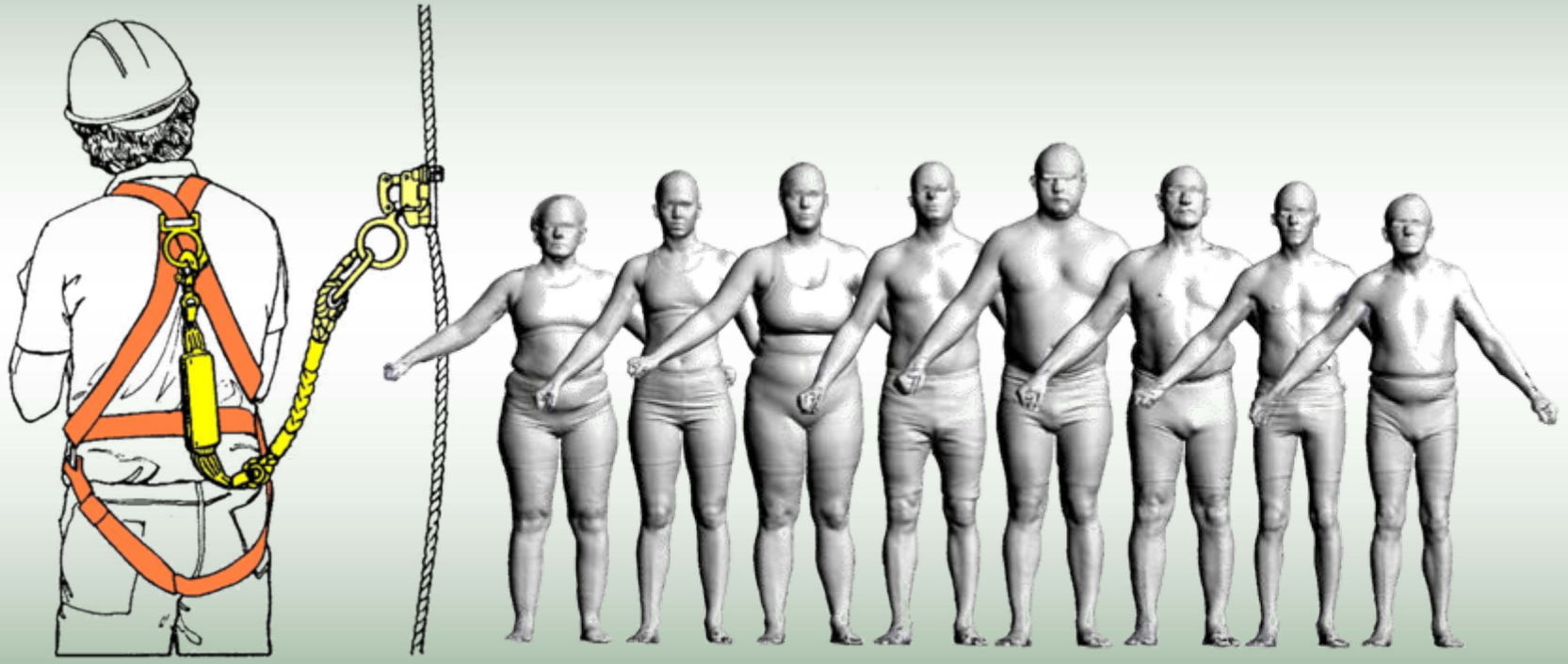


Harness sizing

Suspension trauma

Energy absorber

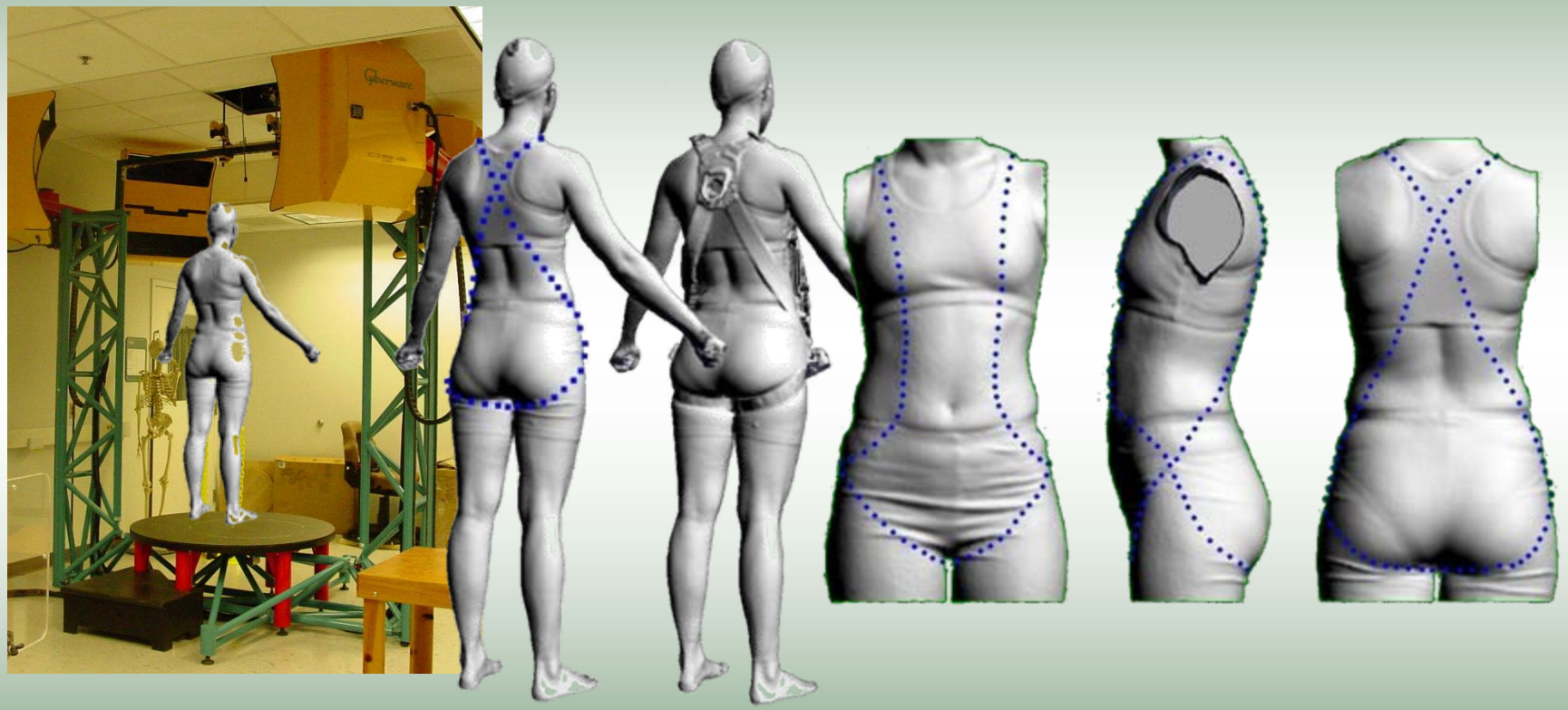
NIOSH Research and Practice
Improved Harness Sizing System (1/6)



Updated harness design for fall protection is needed to accommodate a wider range of body sizes and weights as well as an increased participation by female workers in the current construction workforce.

(Hsiao et al., 2009)

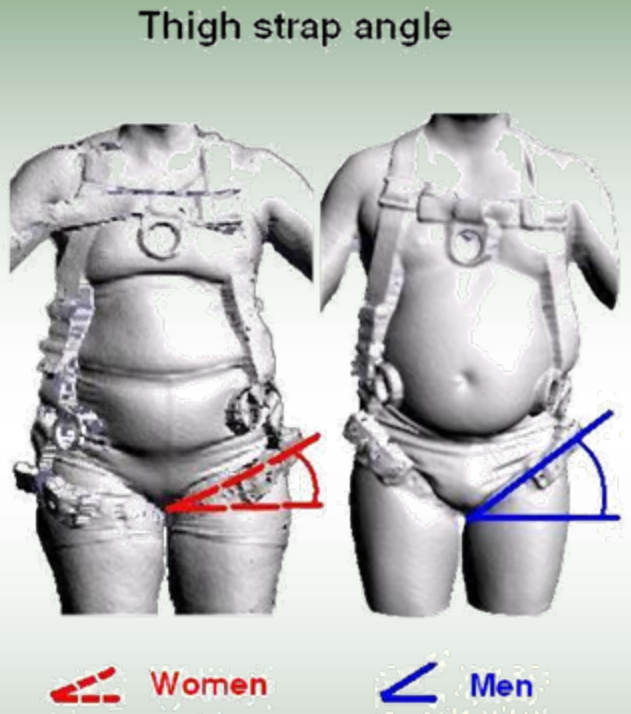
Improved Harness Sizing System (2/6)



Using the most current 3D whole-body digital scanning technology and a revolutionary body-shape quantification method, this project assembled data from the US workforce to establish an improved fall-arrest harness sizing system and design.

(Hsiao et al., 2009)

Improved Harness Sizing System (3/6)

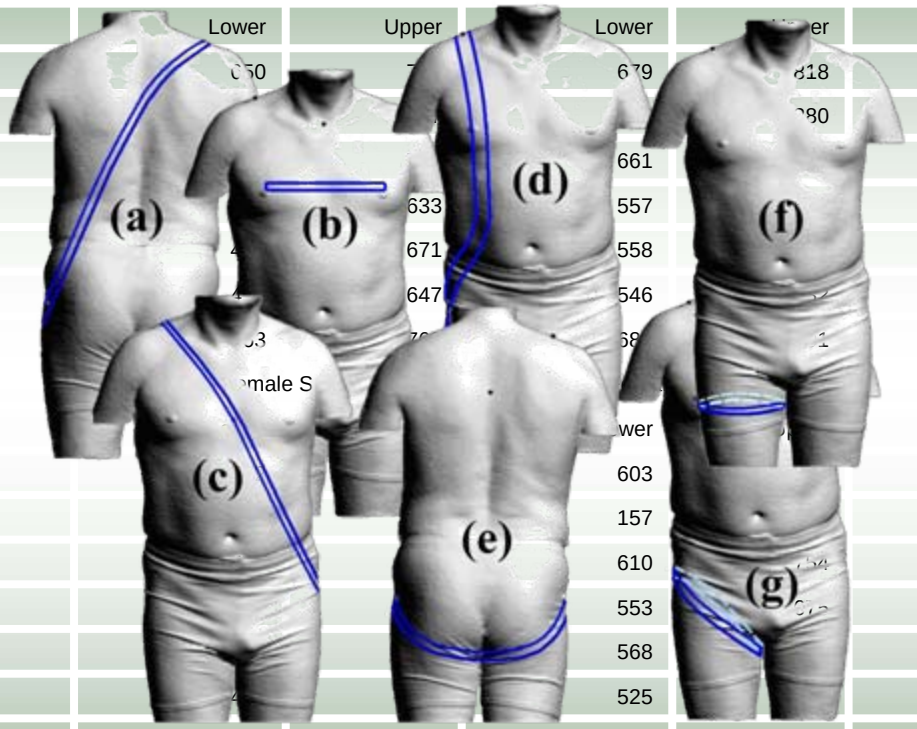


Increased inclination of torso suspension angle (hence fit failure) was associated with a reduction in torso length, a more developed chest, and a “flatter” thigh strap angle; harnesses for women can to be designed with a more upward back D-ring than that of the current unisex design to mitigate this problem. Harness thigh strap can be modified to accommodate pelvic configuration while overcoming torso suspension angle problem.

(Hsiao et al., 2009)

Improved Harness Sizing System (4/6)

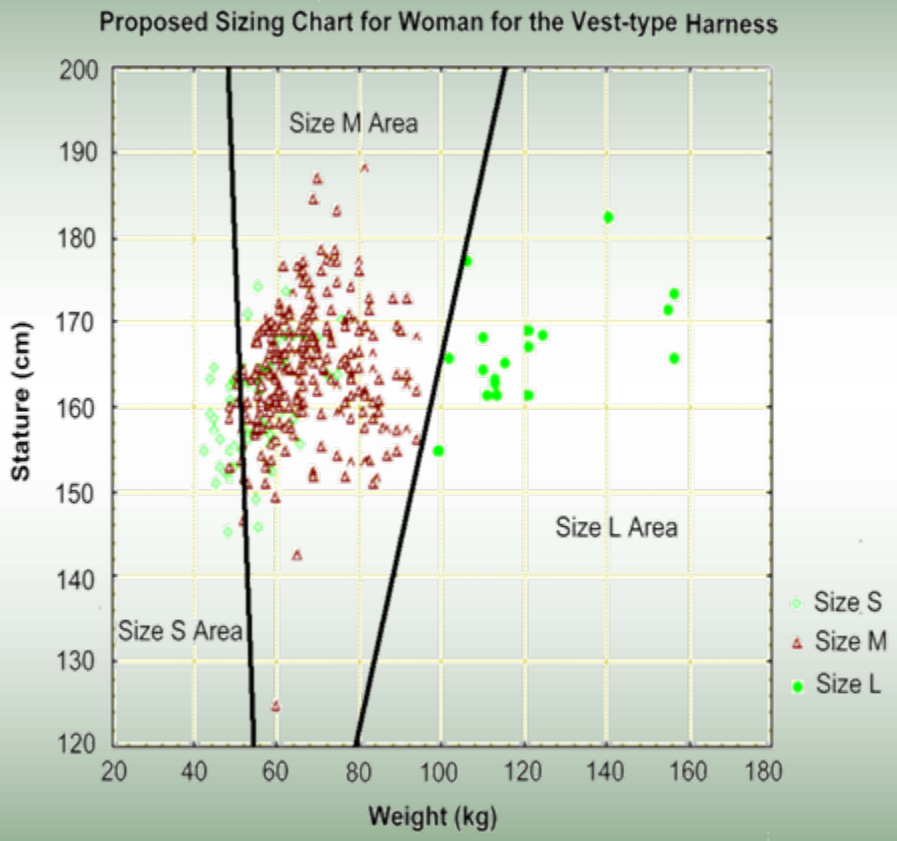
Male	Male S		Male M		Male L	
Harness Component	Lower	Upper	Lower	Upper	Lower	Upper
Back strap (a)	650	7	679	818	746	900
Chest strap (b)	2	2	2	280	213	326
Front cross-chest strap (c)	4	4	661	4	756	930
Front strap (d)	4	633	557	4	641	787
Gluteal Furrow Arc (e)	4	671	558	4	556	785
Thigh circumference (f)	4	647	546	5	601	819
Troch-Crotch cir. (g)	3	7	68	1	764	992
Female	male S				Female L	
Harness Component			wer		Lower	Upper
Back strap (a)			603		677	852
Chest strap (b)			157		186	298
Front cross-chest strap (c)			610		724	931
Front strap (d)			553		631	802
Gluteal Furrow Arc (e)			568		655	825
Thigh circumference (f)	4		525		690	974
Troch-Crotch cir. (g)	577	781	617	849	806	1075

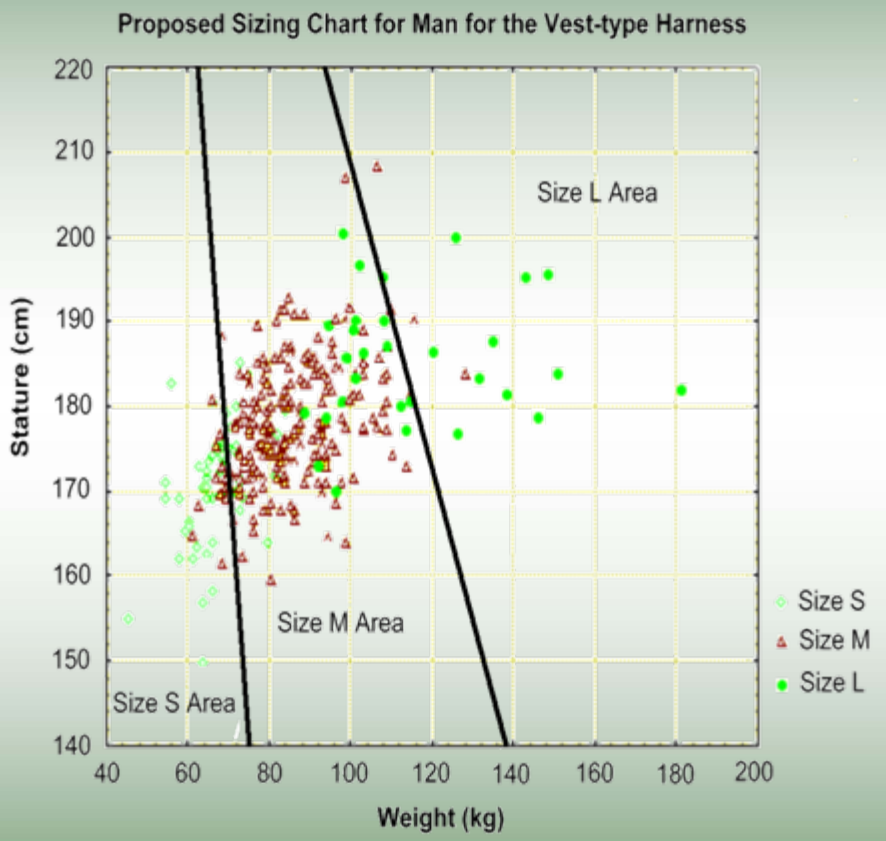


The study outcomes suggested an improved sizing scheme containing 3 sizes for each gender in lieu of the current 4- to 7-size unisex systems. The cut length and adjustment range for each harness strap were proposed.

(Hsiao et al., 2009)

Improved Harness Sizing System (5/6)

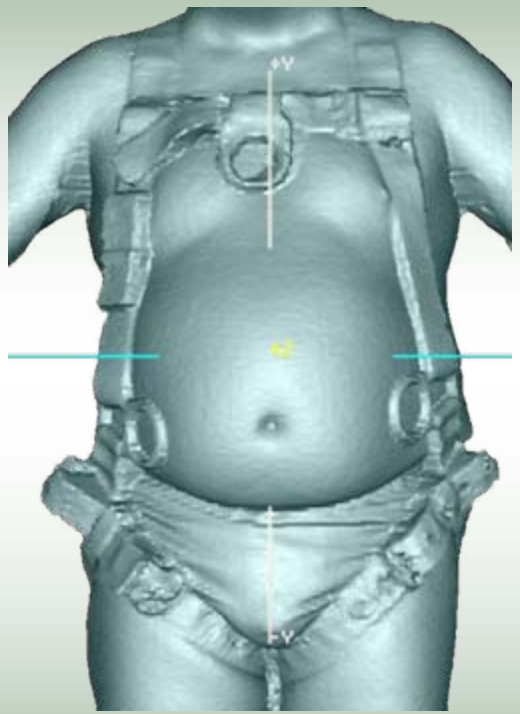




The new sizing charts were graphed by gender, body weight, and body height for manufacturers' use to revise current systems or develop new designs.

(Hsiao et al., 2009)

Improved Harness Sizing System (6/6)



The harness manufacturing industry has used the research results to formulate cost-effective harness-sizing schemes and the next generation harness designs for diverse populations, especially for women and minorities, to provide the required level of protection, productivity, and comfort.

(Hsiao et al., 2009)

NIOSH Research and Practice
Controlling Suspension Trauma (1/4)

http://cache.daylife.comimageserve02nn6bo3P00ux340x.jpg

http://www.fallprotectionusa.com/DBIHarness/Accessories/9501403lg.jpg

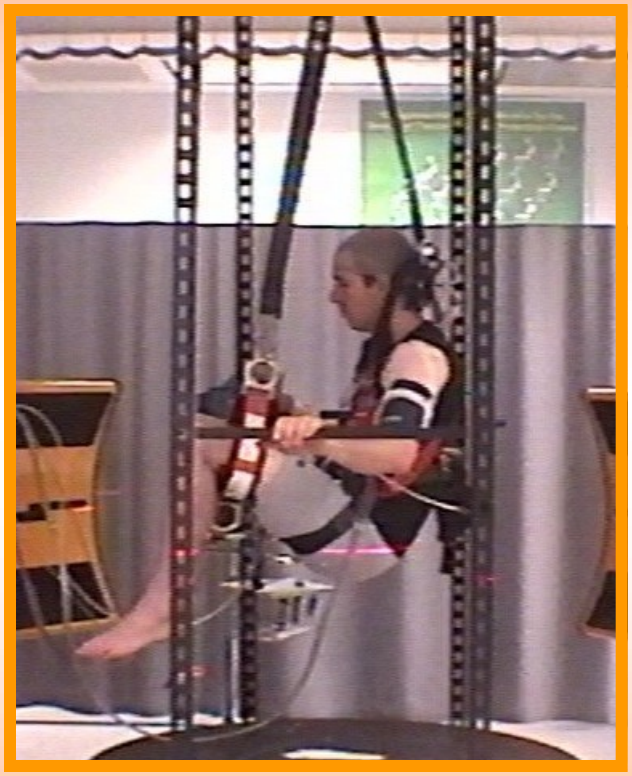
Construction workers are at risk of suspension trauma (insufficient blood flow to the heart) if they are not rescued in time (5~56 minutes; ave. 29 minutes) after a successful arrested fall by a harness.

Controlling Suspension Trauma (2/4)

www.frenchcreekproduction.com

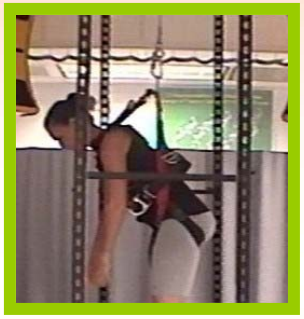
Due to suspension angle, torso configuration, and muscle strength capacity limit, individuals may not be able to manually implement a suspension trauma relief strap, especially when in shock or unconscious.

Controlling Suspension Trauma (3/4)



A harness attachment developed by NIOSH holds the upper legs in an up-right position after a fall, which helps blood flow to the heart preventing the onset of suspension trauma symptoms. The suspension trauma relief strap will deploy even if a worker is unconscious (Turner et al., 2008).

Controlling Suspension Trauma (4/4)

Suspension tolerance time (min)						
Device						
	Mean ± s.d.	Range	n	Mean ± s.d.	Range	n
Men	27 ± 10	5 – 56	20	59 ± 2	51 - 60	15
Women	32 ± 13	5 – 52	17	56 ± 8	39 - 60	11
Total	29 ± 12	5 - 56	37	58 ± 6	39 - 60	26

Next step: Evaluate the force resulting from the accessory as compared to harness

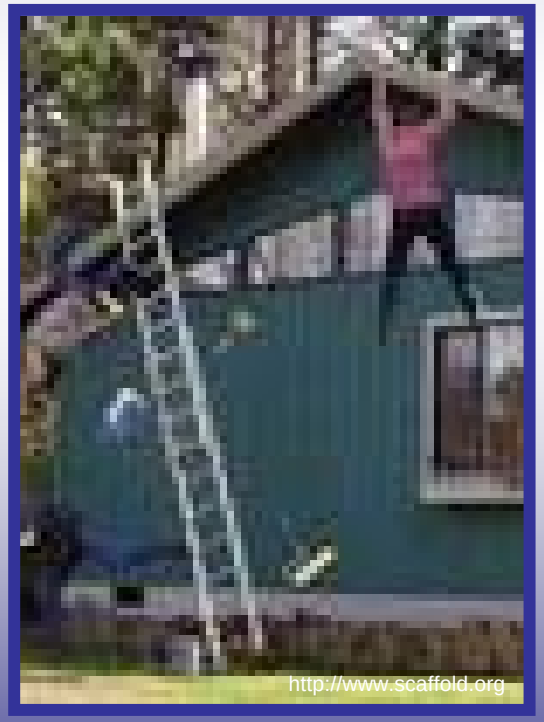
NIOSH Research and Practice
Controlling Impact Energy (1/4)

A typical fall pattern with high risk of death, spinal cord injury, or head injury is when a construction worker falls backwards from an elevated surface (Robinovitch, 1999)

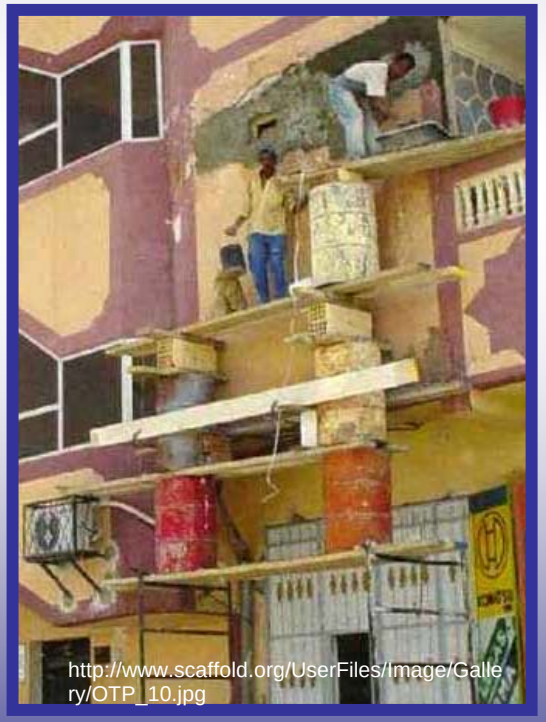
Controlling Impact Energy (2/4)

Culture factors : acceptance of risk as a part of business; tasks are done in a short period of time; small business with limited safety resources; cost and practical issue

Roof



Ladder



Scaffold

Controlling Impact Energy (3/4)

A personal soft-landing device might help in preventing serious injuries from low falls and reduce the injury severity from higher falls

The Itsumo airbag in action (NIIS and Prop Co, Japan)

Horseback-riding fall protection
(Hit Air - Mugen Denko, Japan)

Motorcycle Riders protection
(Dainese, Italy & Merhav AAP, Israel)

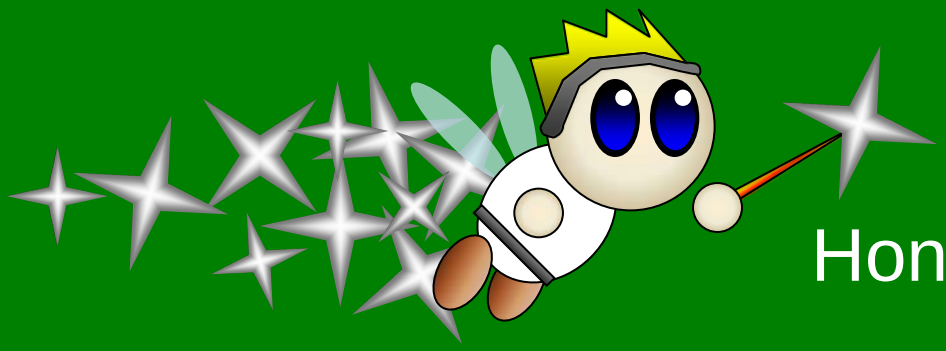
Controlling Impact Energy (4/4)

- **Wearable airbags are a new class of personal fall protection equipment**
- **The device does not require workers' action and is independent of task and environment**
- **Current technological trends will accelerate the safety device improvement**
- **With advancement in durability and cost, wearable airbags may become integral part of workers personal fall protection in the near future**

(Simeonov et al., 2008)

Strategic Goals on PPE for Falls

- Research on PPE fit to diverse worker populations
- Identify and evaluate new technologies to advance PPE development for impact-energy and stress relief
- Transfer research results to industrial design practice and standard development
- Develop evidence-based communication materials on PPE selection and use for employers and workers
- Enhance research and practice collaboration among partners/stakeholders



Questions?

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